STANDARDISED MODULAR SYSTEM FOR MOULDS OF INJECTION MOULDING MACHINES

DESCRIPTION

[0001] The present invention refers to a standardised modular system for moulds of injection moulding machines.

[0002] As is known, an injection moulding machine comprises one or more moulds defining respective cavities wherein the plastic material for formation of the moulded item is injected.

[0003] A mould generally comprises a fixed mould half and a movable mould half which moves from a mould closed position wherein the plastic material is injected to a mould open position wherein the moulded item is ejected. Accordingly, an injection assembly of the moulding machine acts on the fixed mould half for injection of the plastic material and an ejection assembly of the moulding machine acts on the movable mould half for ejection of the moulded item.

[0004] Each mould defines a cavity designed and shaped according to the item to be moulded. Consequently, when production is changed, the entire mould and thus also the injection and ejection assemblies that interface with said mould must be changed.

[0005] When the production change requires minimal changes on the moulded item, the same mould can be maintained and changes can be made to the injection assembly, for example by changing the injectors or the injection modalities. Alternatively, the male and female elements of the mould that define the cavity can be replaced.

[0006] Said changes are nevertheless carried out without any rule and are left to the initiative of the person skilled in the art. In any case, when substantial changes in production are to be made, the entire mould and thus the injection and ejection assemblies must be changed with a consequent excessive waste of money, time and material.

[0007] The object of the present invention is to overcome the drawbacks of the prior art, providing a system for the moulds of injection moulding machines that is of the modular type.

[0008] Another object of the present invention is to provide such a moulding system that is versatile and able to be adapted to the different types of production change.

[0009] These objects are achieved in accordance with the invention with the characteristics listed in appended independent claim 1.

[0010] Advantageous embodiments of the invention are apparent from the dependent claims.

[0011] The standardised modular system for moulds of injection moulding machines according to the invention comprises:
- an injection assembly provided with a plurality of injectors for injecting of the plastic material into the mould,
- an ejection assembly provided with a plurality of ejectors for ejecting of the moulding from the mould, and
- a mould comprising a fixed mould half associated with said injection assembly and a movable mould half associated with said ejection assembly and movable from a mould closed position wherein the plastic material is injected into the mould and a mould open position wherein the moulding is ejected from the mould.

[0012] The peculiar characteristic of the invention lies in the fact that the modular system further comprises:
- female mould inserts comprising a female cavity and male mould inserts comprising a male protrusion removably mounted in appropriate seats formed respectively in a female mould plate of the fixed mould half and in a male mould plate of the mobile mould half so as to be modularly composable and decomposable, according to the moulding to be produced,
- first adapter means disposed interchangeably between said injection assembly and said fixed mould half so as to allow the arrangement of said injectors of the injection assembly to be varied, and

- second adapter means disposed interchangeably between said ejection assembly and said mobile mould half so as to allow the arrangement of said ejectors of the ejection assembly to be varied.

[0013] Said standardised modular system for moulds of injection moulding machines according to the invention has various extrinsic and intrinsic advantages as listed below.

[0014] Extrinsic qualities (seen by the user):
- Efficiency - The quality of the individual modules and components allows rational use to be achieved.
- Usability – The great flexibility of the system allows an unlimited field of application to be satisfied.
- Economy – On large numbers of product types, the reduction in costs becomes considerable.
- Accuracy – The correct execution of each component facilitates interchangeability and the highest quality requirements.

[0015] Intrinsic qualities (seen by the designer)
- Maintainability – The interchangeability of the modules of each individual standardised component allows replacement costs and mould-stopping times to be reduced drastically.
- Extendability – There are no limits to the possibility of application of the principle of the system according to the invention.

[0016] The system according to the invention, according to the basis of the principles of modularity, is characterised by a well structured architecture, consisting of modules that are well connected to each other. The construction of the moulds according to this methodology leads to great flexibility of operation and of configuration, together with functionality, versatility and speed of construction. Said system has the following features:
- Decomposability – The system can be decomposed and rebuilt with different components which in turn can be further decomposed into various parts, joined in a simple structure.
- Composability – The modular system facilitates the production of elements which can be combined together to give the mould different characteristics.

- Comprehensibility – Some parts that make up the modular system can be identified by an observer, without said observer necessarily having to know the other parts of the system.
- Continuity – The system makes a small change in the system specification correspond to a an equally small change in implementation.
- The modular system according to the invention confines the effects to the inside of the module in which they occur, or at most to a limited number of modules.

[0017] Therefore these properties of the system according to the invention perfectly respect the principle of modularity and each module does not relate with other modules, thus giving the product different characteristics.

[0018] Further characteristics of the invention will be made clearer by the detailed description that follows, referring to a purely exemplary and therefore non limiting embodiment thereof, illustrated in the appended drawings, wherein:

[0019] Figure 1 is an axonometric exploded view generally illustrating a standardised modular system for moulds of injection moulding machines according to the invention;

[0020] Figure 2 is a diagrammatic exploded side view, illustrating the various elements of the modular system of Figure 1;

[0021] Figure 3 is an axonometric exploded view, illustrating the modular system of Figure 1 enlarged and wherein the injection assembly and the temperature conditioning inserts have been omitted;

[0022] Figure 4 is a sectional view of the modular system of Figure 1, assembled, in the mould open condition, and in the stage of ejection of the moulded item.

[0023] A standardised modular system for moulds of injection moulding machines according to the invention, denoted as a whole by reference numeral 100, is described with the aid of the figures.

[0024] Purely by way of example the modular system 100 has been illustrated in the figures in a horizontal arrangement, it being understood that the modular system 100 can also be disposed in a vertical configuration for vertical presses.

[0025] The modular system 100 substantially comprises an injection assembly 1 for injection of the molten plastic material , a moulding assembly 2 for formation of the moulded item and an ejector assembly 5 for ejection of the moulded item from the moulding assembly 2.

[0026] The moulding assembly 2 comprises a mould consisting of a fixed mould half 3 integral with the injection assembly 1 and a mobile mould half 4 integral with the ejection assembly 5. The mobile mould half 4 moves horizontally from a mould closed position wherein the plastic is injected into the mould cavity for formation of the moulded item to a mould open position, wherein the item formed in the mould cavity is expelled through the intervention of the ejection assembly 5.

[0027] The injection assembly 1 comprises a plate structure 10 consisting of two rectangular plates 11 and 12 spaced apart form each other by spacers 13. A plurality of shutter injectors 14 which protrude from the plate 12 of the injection assembly towards the mould are mounted in the plate structure 10.

[0028] The injectors 14 are suitable for aesthetic moulding (without sprue) and consist of injection nozzles having shutter means. Said injectors 14 are interchangeable, can be small in size and very compact, and can be disposed in different positions to be able to adapt to different types of mould layout.

[0029] In the plate 12 of the plate structure 10 of the injection assembly there are provided centring pins 15 which protrude towards the mould for correct alignment of the injectors 14. The centring pins 15 of the injection assembly engage in special holes made in a female mould plate 30 forming part of the fixed mould half 3.

[0030] The female mould plate 30 has in its surfaces facing towards the injection assembly a plurality of seats 31, for example four in number, able to receive respective heat-regulating inserts 8 having a substantially rectangular shape with rounded ends. Each insert 8 has a plurality of through holes 80, for example six in number, disposed in a row, to allow the passage of the injectors 14. The inserts 8 are heat-regulated to control the injection temperature of the injectors 14.

[0031] Seats are formed in the surface of the female mould plate 30 facing towards the mobile mould 4, for example four in number, disposed beneath the seats 31 of the temperature conditioning inserts 8, to receive the respective female mould inserts 32 which define the moulding matrix.

[0032] Each female mould insert 32 is substantially shaped as a rectangular plate and has, in the surface thereof facing towards the mobile mould half 4, a female cavity 34 (Figure 4) wherein the plastic material for formation of the moulded item will be injected. Accordingly, each female mould insert 32 has a plurality of through holes 33, for example six in number, disposed in a row, to allow injection of the plastic material by the injectors 14 into the cavity of the female mould inserts 32. Consequently the holes 33 of the female mould inserts 32 will be aligned with the holes 80 in the heat-regulating inserts 8.

[0033] Four horizontal tiebars 35 are disposed at the four corners of the female mould plate 30. On each major side of the female mould plate 30, on the other hand, inclined tiebars 36 are provided, for example four in number on each side, which protrude outwardly sideways from the female mould plate 30.

[0034] The mobile mould half 4 comprises a male mould plate 40, substantially rectangular in shape, which has in the surface thereof facing the fixed mould half 3 a plurality of sets 41, for example four in number, able to receive respective male mould inserts 42 which define the moulding male to be coupled with the female cavity.

[0035] Each male mould insert 42 is shaped substantially as a rectangular plate and has in the surface thereof facing towards the fixed mould half a male protrusion 44 (Fig 4) which couples with the female cavity 34 of the respective female mould insert 32 to define a mould cavity wherein the plastic material for formation of the moulded item will be injected.

[0036] In the present description the terms male and female have been used purely by way of it example, it being understood that both the inserts 32 of the fixed mould half and the inserts 42 of the mobile mould half 4 can provides for cavities and/or protrusions, variously disposed and shaped.

[0037] Slides 20, four in number, are mounted on the major sides of the male mould plate 40, two on each major side. The slides 20 can translate transversally between two end guide elements 28 disposed at the opposite ends on the minor sides of the male mould plate and two intermediate guide elements 29 disposed in a median position on the major sides of the male mould plate.

[0038] Four bushes 45 which pass through the end guide elements 28 to engage with the horizontal tiebars 35 of the mould are integrated on the four corners of the male mould plate 40. In this manner the movable mould half 3 can translate guided on the tiebars 35.

[0039] Each slide 20 is connected to a respective male mould insert 42, by means of a connecting element 21 provided with a plurality of transverse pins 22 which engage in special seats in the side edge surface of the male mould insert 42. Each slide 20 has two slot-shaped seats 26 able to receive two respective inclined tiebars 36 of the female mould plate 30.

[0040] When the mould has to be opened the male mould plate 40 moves away from the female mould plate 30 (moving horizontally towards the left with reference to the Figures), thus the inclined tiebars 36 slide in the slots 26 of the slides consequently causing the slides 20 to move away from the ends of the male mould inserts 42. In this manner it is possible to eject from the male inserts 42 even items having undercut parts, which would otherwise be blocked in the respective inserts because of interference with the slides 20.

[0041] Heat-regulating inserts 83 are positioned in the surface of the male mould plate 40 facing towards the ejection assembly. Both the heat regulating inserts 83 and the male mould inserts 42 have a plurality of through holes aligned with each other for passage of the punches of the ejector assembly, for ejection of the moulded item, as will be described hereunder.

[0042] The ejection assembly 5 comprises a base plate 50 whereto is connected a pneumatic cylinder 51 wherein a piston consisting of a plunger 52 and a shaft 53 slides horizontally. The arrow F in Figure 4 indicates the direction of ejection pressure. A channel 156 is formed in the base plate for the passage of air to keep the plunger 52 in a retracted position during moulding.

[0043] On the base plate 50, two rests 54 are fixed to the longest sides and supports 55 are fixed in an intermediate position between the rests. The rests 54 and the supports 55 integrally support the male mould plate 40. In this manner the ejection assembly 5 is made integral with the movable mould half 4.

[0044] A first group of rear ejector plates 56, for example four in number, is disposed on the inner surface of the base plate 50, between the rests 54 and the supports 55. As shown in Figure 4, the rear ejection plates 56 have a plurality of seats for assembly of the horizontal guide shafts 57 of telescopic ejectors.

[0045] A rear table 58, which has a number of seats 59 able to receive the rear plates 56, is fixed to the base plate 50 so as to retain the rear ejector plates 56.

[0046] The ejection assembly has four horizontal tiebars 61 passing through the four corners of the rear table 58. Each tiebar 61 of the ejector assembly has one end engaged in a bush 60 integral with the base plate 50 and the other end engaged in another bush 49 integral with the male mould plate 40.

[0047] An intermediate table 62 and a front table 63, each having respective opposite seats 64, 65 to receive respectively a second group of intermediate plates 66 and a third group of front plates 67 are mounted horizontally slidably on the tiebars 61 of the ejector assembly. The intermediate and front tables 62, 63 are fixed to each other, so as to close the intermediate and front plates 66, 67 in a pack therebetween.

[0048] Furthermore, the intermediate and front tables 62, 63 are fixed to the shaft 53 (Figure 4) of the pneumatic piston, so as to be able to be moved horizontally along the tiebars 61 of the ejector assembly, by means of movement of the piston inside the cylinder 51.

[0049] The intermediate plates 66 have a plurality of through holes able to allow the passage of the guide shaft 57 of the telescopic ejector. The top plates 67, on the other hand, have a plurality of seats to house punch-shaped ejectors 68 and/or telescopic ejectors 69. The telescopic ejector has a sleeve 69 hollow on the inside which slides telescopically on the respective guide shaft 57.

[0050] In this manner operation of the shaft 53 of the piston 52 horizontally moves the intermediate and front tables 62, 63, together with the telescopic ejectors 69 and the punch ejectors 68, from a retracted position to a deployed position of ejection of the moulded item. The telescopic ejectors 69 and the punch ejectors 68 pass through the holes of the heat-regulating inserts 83 and the male inserts 42 to push the moulded item 90 (Figure 4) so as to eject it from the mould. It should be noted that if the moulded item has circular parts 91, it is preferable for the telescopic ejectors 69 to act in said circular parts 91.

[0051] Obviously, when production is changed the male and female mould inserts 42 and 32 which define the shape of the item to be moulded must be changed. Consequently, it may also be necessary to change the heat-regulating inserts 8, 83 to adapt them to the shape of the new inserts. Lastly it is necessary to change the arrangement of the injectors 14 (for example activating only some of them) and of the ejectors 68, 69 according to the piece to be moulded. The plates 56, 66 and 67 of the ejector assembly may also be changed if necessary, as may the elements 21 connecting the slides 20 to the male mould inserts 42.

[0052] All the other parts, on the other hand (that is to say, the plate structure 10 of the injection assembly, the female mould plate 30 of the fixed mould half, the male mould plate 40 of the movable mould half, the tables 58, 62, 63, the base plate 50 and the cylinder-pneumatic piston assembly of the ejector assembly) which make up the structure of the modular system 100 remain unchanged.

[0053] Numerous variations and modifications of detail, within the reach of a person skilled in the art, can be made to the present embodiment of the invention, without departing from the scope of the invention, as set forth in the appended claims.